UNITED STATES PATENT APPLICATION

FOR

METHOD, APPARATUS AND SYSTEM FOR COMMUNICATING HEALTHCARE

INFORMATION TO AND FROM A PORTABLE, HAND-HELD DEVICE

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METHOD, APPARATUS AND SYSTEM FOR COMMUNICATING HEALTHCARE INFORMATION TO AND FROM A PORTABLE, HAND-HELD DEVICE

5 **RELATED APPLICATION**

This application claims the benefit of US provisional application No. 60/166, 643, filed November 19, 1999.

FIELD OF THE INVENTION

10 The present invention relates to the selection and transmission of healthcare information relating to a patient.

BACKGROUND

Medical practitioners and other healthcare professionals are required 15 frequently to record details of patients whom they are treating, in particular details of any diagnosis which may be made of a patient's condition following a consultation. However, due to the pressure under which medical practitioners operate, it may be difficult for them to find the time to enter the necessary information. It is desirable that the means available to

medical practitioners for recording the relevant healthcare information

should be as effortless and as seamless as possible.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a method of communicating healthcare information. A set of codes each corresponding to respective healthcare data is generated. The set of codes is stored in a memory associated with a portable terminal. Selection of at least one code corresponding to healthcare data relevant to a patient is detected, where after the selected at least one code is wirelessly transmitted to a recipient.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will be more fully understood by reference to the accompanying drawings, in which:

5   **Figure 1** shows a simplified block diagram of a system for communicating healthcare information according to the present invention;

Figure 2 shows a representation of a cellular telephone used in the system and method of the present invention, with healthcare data codes 10   according to the present invention displayed thereon;

Figure 3 shows the display of the cellular telephone of Figure 2, indicating an alternative display scheme for lists of healthcare data codes according to the present invention;

15

Figures 4A - 4D illustrate respective healthcare event capture screens for a Palm VII device, according to an exemplary embodiment of the present invention; and

Figure 5 shows a simplified flow chart of basic steps in the method of the present invention.

DETAILED DESCRIPTION

In the following description, for the purposes of explanation and illustration, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be

5   obvious to one skilled in the art that the present invention may be practiced without the specific details. Further, the provided details provide only exemplary embodiments of the present invention.

The method and system of the present invention were designed to complement the invention described in US patent application serial number

10   09/591,769, filed June 12, 2000, the contents of which are incorporated herein by reference. In essence, the present invention provides a method and system (also referred to as WirelessMed herein) for communicating healthcare information to the system described in the above-mentioned US patent application, which is particularly efficient and convenient.

15   US patent application serial number 09/591,769, filed June 12, 2000, describes a method and system in which information about a patient is received by the system. Typically, the information includes data identifying the patient, and diagnosis information that is based upon a diagnosis of the patient performed by a healthcare provider. When the information is

received, a query function is performed which retrieves from a database a list of data sources that correspond to the information received. One or more documents are generated that contain a list of data sources retrieved from the database, and which contain information relevant to the diagnosis. These documents are then made accessible to the patient, for example, via the Internet/World Wide Web.

The method and system thus provide information to patients or healthcare consumers by providing them with relevant and personalized health related information that is tailored to their needs following their interaction with a healthcare provider. In a preferred version of the method and system, a Web document referred to as MyMedstory (TM) is created which is accessible by a patient via the Internet and which enables the patient to obtain further information about his or her medical condition, diagnosis and treatment, for example, following on a visit to the healthcare provider.

In the above-described patent application, a method is described by means of which healthcare providers can use a browser client program to provide information about their patients to the system. This method typically entails the use of an Internet browser and a computer terminal to

access the system and communicate the relevant data. It will be appreciated

that it is important to communicate the relevant data to the system as soon

as possible in order for the highest possible efficiency levels to be achieved.

Until the data has been so communicated, the corresponding information

5   cannot be retrieved from the database and made available to the patient or

other interested party.

The present invention addresses this need for rapid and convenient

transmission of information by providing a hand-held portable terminal that

can be used for selection and transmission of relevant healthcare data in the

10   method and system described above.

Referring now to **Figure 1**, a patient 10 consults a healthcare provider

12, for example, to be diagnosed in respect of an ailment or illness. On

diagnosing and treating the patient, the healthcare provider selects one or

more of a number of possible codes from a list of healthcare data codes

15   stored on a portable terminal 14 and transmits the selected code or codes via

a first, wireless network 16 to a gateway 18. The portable terminal 14 may

be aWAP-enabled telephone, or another portable device with wireless data

connectivity such as a Palm, Handspring, or Blackberry PDA device. The

portable terminal 14 may also be a laptop or portable computer to a wireless

data network. The wireless network 16 can be, for example, a CDMA

network, a GSM network, a TDMA network, a GPRS network, a UTMS

network, a proprietary wireless data network such as Mobitex, Motient,

Metricom aCDPD network , a bluetooth-based network, or another wireless

5   network with suitable capabilities. The gateway 18 serves as an interface

between the wireless network 16 and a second network 20, which is typically

the Internet/World Wide Web.

In the system shown in **Figure 1**, the gateway 18 connects the wireless

network 16 to the second network 20 via an application server 22 with an

10   associated database 24, and a Web server 26. The use of the application

server 22 and its associated database 24 makes it possible to retrieve further

information which is made available to the patient, according to the

invention described in US patent application number 09/591,769, filed June

12, 2000. Of course, it is also possible to connect the network 16 to the

15   network 20 directly the via the Web server 26 in a more streamlined or

simplified arrangement. In this latter case, the information made available

via the network 20 would correspond exactly to the healthcare data

comprised by the selected code or codes.

In the illustrated example, the codes transmitted by the healthcare

provider (e.g., physician) are appropriate medical codes (including but not

limited to ICD-9-CM or ICD-10-CM diagnosis codes, HCPCS/CPT codes,

SNOMED codes or other codifications). Each code corresponds to a

5   respective diagnosis or other healthcare or biomedical data. The received

codes may be used for a wide variety of applications, from financial and

medical or clinical functions to patient information systems. The

information retrieved from the database 24 by the application server or 22 is

then made available to the patient or other end users in a variety of forms

10   and via a variety of means, including but not limited to: World Wide Web

pages or documents, television or web television, cellular telephones, web-

enabled cellular telephones, internet appliances, game stations or other

platforms.

Figure 2 shows an exemplary portable terminal 14 in the form of a

15   generally conventional Web-enabled cellular telephone which has been

adapted by storing a list or set of codes in the telephone memory, each code

corresponding to health care data codes such as those determined by the

existing ICD – 9 or future ICD – 10 protocols. The portable terminal 14 may

execute any one of a number of known operating systems, such those

developed by Nokia, Palm Computing (the Palm operating system), Psion,

Symbian, Microsoft (e.g., the Pocket Windows operating system).

As shown in **Figure 2**, the telephone screen 28 displays a list of codes

30 which are organized alphabetically by diagnosis. Using the scrolling keys

5   of the telephone, the desired diagnostic code can be selected and entered for

transmission. **Figure 3** shows an alternative display wherein the screen 28

shows a list 32 in which the codes are organized according to medical

categories or subfields, as illustrated. In this case, on selecting a category,

the user is presented with further sub categories or appropriate codes in the

10   selected category. The appropriate code or codes then selected as described

above. This interface can also be used for rapid access to more detailed

codes relating to the same condition. For example, bronchiolitis is coded as

466.1, but the more precise description "bronchiolitis, chronic" is coded as

506.4. Thus, the system can be used to rapidly navigate the coding

15   classification. By way of a further example, the codes could be classified by

code order, rather than alphabetical order.

By selecting the appropriate code from the displayed list, the

healthcare provider can enter any common condition, procedure or other

medical event or information code relevant to the patient, and communicate

it to the application server 22 via the wireless cellular network 16 and the gateway 18.

There will likely be several standards for communicating information over Internet enabled telephones or other mobile devices. The following

5   example is a "WAP" example (Wireless Application Protocol) using the "WML" language (Wireless Markup Language) derived from XML. The example code describes an instance of the WML interface for rapid, mobile, ubiquitous, easy-to-use and reliable presentation of healthcare codes. The underlying programming language to manage the communication can be

10   WMLScript. An interpreter for WMLScript is to be included in the majority of upcoming cellular phones and will be included as well in other appliances.

In the present example, transmission of data is done via the WAP Protocol. Other existing protocols may be used. For example, the Palm VII

15   wireless PDA or a similar wireless-capable PDS device may be used to capture the same information healthcare event information. The Palm VII has a larger screen than most cellular phones and supports a version of HTML called cHTML or "clipped HTML." Clipped HTML supports almost all of the interface elements of standard HTML including buttons, drop-

down menus, checkboxes, radio buttons, etc. cHTML-based displays can be

built that allow the user to easily enter the age, sex, codes, and any other

healthcare event information using interface controls identical to those that

would be used for data entry on a standard browser web page. Typically

5　these devices have touch-sensitive screens that accept the input of a special

stylus, sharp object, or even the tip of a finger. The user of these devices

may also use one or more buttons located on the device to enter and select

information presented on the device. Some popular PDAs such as the

Blackberry do not have touch sensitive screen but rather a small keyboard

10　that is used to enter and select information on the device display.　Figure 4

shows a working example of a healthcare event capture screen for a Palm

VII device. The user can select the type of event from a drop-down box,

enter the age and sex, select the diagnostic code, select the lab request or

procedure code, and select the information target using the stylus. When the

15　information entered on the screen by the user is complete, the user presses

on a "zerosearch" button and the information is sent via the wireless data

network to an Internet connected server that can process the request. An

acknowledgement that the information has been received and validated is

then sent back from the Internet connected server via the wireless data

network to the Palm VII device.

It will be appreciated by those skilled in the art that the method and

system of the present invention are independent of the specific protocol or

5   wireless network technology employed.

Example using WML protocol

<?xml version="1.0"?>

<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"

"http://www.wapforum.org/DTD/wml_1.1.xml">

10   <wml>

<!--Copyright by Medstory.Com

All rights reserved. Confidential Medstory.Com

-->

<!-- List of selected ICD-9-CM codes for a pediatrics practice

15   to be selected by user and transmitted via cellular network with

gateway into Internet

-->

        <card id="ICD-9-CM" title="ICD-9-CM Main Codes">

            <p>

```
<select name="code" tabindex="2">

<option value="789.0">789.0 - abdominal pain</option>

5    <option value="706.1">706.1 - acne</option>

<option value="349.9">349.9 - attention deficit disorder</option>

<option value="309 ">309 - adjustment reaction non-specific</option>

<option value="285.9 ">285.9 - anemia</option>

<option value="493">493 - asthma</option>

10   <option value="919.4 ">919.4 - bite insect</option>

<option value="490 ">490 - bronchitis</option>

<option value="466.1 ">466.1 - bronchiolitis</option>

<option value="949.0 ">949.0 - burn</option>

<option value="682.9 ">682.9 - cellulitis dacryocystitis</option>

15   <option value="789.0 ">789.0 - colic</option>

<option value="372.3 ">372.3 - conjunctivitis</option>

<option value="850 ">850 - concussion</option>

<option value="554.0 ">554.0 - constipation</option>

<option value="298.9 ">298.9 - confusion</option>
```

```
<option value="691.8 ">691.8 - cradle cap</option>

<option value="464.4 ">464.4 - croup</option>

<option value="375.30 ">375.30 - dacryocystitis</option>

<option value="375.56 ">375.56 - dacryostenosis</option>

<option value="276.5 ">276.5 - dehydration</option>

<option value="37691.8 ">691.8 - dermatitis atopic</option>

<option value="692.9 ">692.9 - dermatitis contact</option>

<option value="691.0 ">691.0 - diaper rash</option>

<option value="832.00 ">832.00 - dislocation elbow</option>

<option value="995.2 ">995.2 - drug allergy</option>

<option value="380.4 ">380.4 - ear wax</option>

<option value="788.3 ">788.3 - enuresis</option>

<option value="782.1 ">782.1 - non specific exanthem</option>

<option value="780.6 ">780.6 - fever</option>

<option value="487.1 ">487.1 - influenza</option>

<option value="829.0 ">829.0 - fracture</option>

<option value="009.2 ">009.2 - gastroenteritis</option>

<option value="074.3 ">074.3 - hand foot mouth disease</option>

<option value="784.0 ">784.0 - headache</option>
```

5

10

15

```
<option value=" V20.2 ">V20.2 - health check-up</option>

<option value="785.2 ">785.2 - heart murmur</option>

<option value="228.0 ">228.0 - hemangioma</option>

<option value="708">708 - hives</option>

<option value="272.0 ">272.0 - hypercholesterolemia</option>

<option value="401.1 ">401.1 - hypertension</option>

<option value=" V05.9 ">V05.9 - immunization vaccination</option>

<option value="684 ">684 - impetigo</option>

<option value="783.3 ">783.3 - feeding difficulty</option>

<option value="774.6 ">774.6 - jaundice</option>

<option value="683 ">683 - lymphadenitis</option>

<option value="457.2 ">457.2 - lymphangitis</option>

<option value="579.8 ">579.8 - intestinal malabsorption</option>

<option value="075.0 ">075.0 - infectious mononucleosis</option>

<option value=" M872.00 ">M872.00 - nevus</option>

<option value="388.70 ">388.70 - otalgia earache</option>

<option value="380 ">380 - otitis externa</option>

<option value="382.9 ">382.9 - otitis media</option>

<option value="462 ">462 - pharyngitis</option>
```

```
<option value="486 ">486 - pneumonia</option>

<option value="692.6 ">692.6 - poison oak</option>

<option value="477.9 ">477.9 - rhinitis allergic</option>

<option value="057.8 ">057.8 - roseola infantum</option>

<option value="461 ">461 - sinusitis</option>

<option value="848.9 ">848.9 - sprain</option>

<option value="528.0 ">528.0 - stomatitis</option>

<option value="034.0 ">034.0 - strep throat</option>

<option value=" V58.3 ">V58.3 - suture and removal</option>

<option value="079.99 ">079.99 - viral syndrome</option>

<option value="520.7 ">520.7 - teething</option>

<option value="771.7 ">771.7 - thrush</option>

<option value="463 ">463 - tonsillitis</option>

<option value="686.1 ">686.1 - umbilical granuloma</option>

<option value="465 ">465 - upper respiratory infection</option>

<option value="599.0 ">599.0 - urinary track infection</option>

<option value="616.10 ">616.10 - vaginitis</option>

<option value="052.9 ">052.9 - varicella</option>

<option value="078.1 ">078.1 - warts</option>
```

```
<option value="308.3 ">308.3 - post traumatic stress</option>

<option value="910.7 ">910.7 - splinter</option>

</select>

        </p>

5       </card>

</wml>
```

Upon selecting a category, the user finds other sub-categories or appropriate codes in the selected category. The code(s) is or are selected in

10   accordance with the situation or health care event to be reported.

Once one or more codes are entered, they are transmitted from the portable terminal 14 via the wireless network 16 using the Wireless Application Protocol to the gateway 18. The functionality of the gateway 18 includes protocol adapters that change the URL specified in the WAP

15   protocol into a traditional HTTP request over the World Wide Web. The latter can trigger the execution of a script on the server side to access a database or other of information. The implementation is independent of the languages used that may include CGI, Java, Jini, Perl and others.

Returning information, the server 22 includes the new WML "deck" to the

gateway 18 that in turn generates a WAP response via the wireless network

16 to the portable terminal 14. For example, the application may request a

re-entry of the code for verification, or may provide an explanation to the

5   user. Other information that may be transmitted in concurrence with the

codes includes other codes (from the same or other codification), age, sex,

date of birth, name, or other information.

Example Using cHTML for a PalmVII Wireless PDA

10   **Figures 4A - 4D** provide an example which uses other client

interfaces for capturing the data. Specifically, **Figures 4A - 4D** illustrate

exemplary interfaces that may be presented on a personal digital assistant

(PDA), such as the Palm VII, utilizing cHTML to capture the relevant data.

Figure 4A illustrates an exemplary data entry interface 60 that may be

15   presented on a PDA 62 to facilitate the entry of event type information and

parameters that are then communicated in a wireless manner from the PDA

62 to the application server 22.

Figure 4B illustrates an exemplary information interface 64, which

displays returned information via which the entered information may be

-21-

confirmed. **Figures 4C** and **4D** illustrate exemplary pull-down menus 66

and 68, that may be invoked for example from the input interface 60 to

facilitate the input of meaningful codes. An example of the cHTML that

may be utilized to present such codes is provided below.

5   The codes transmitted may be "Order Codes", i.e. commercial codes

used by a specific clinical laboratory company; these are generally mapped

to CPT-2000 or CPT-2001 (new edition) codes.

```
<HTML><HEAD>

<meta name="palmcomputingplatform" content="true">
```

10
```
<TITLE>Event Capture</TITLE>

</HEAD><BODY>

<FORM method="get" action="http://medstory.com/palm/visitor.jsp">

<table border="0" cellpadding="0" cellspacing="0">

<tr valign='center'>
```

15
```
<td valign='center'><IMG src="medlogopalm.jpg"></td>

</tr></table>

<BR>

<TABLE align=left border=0 cellPadding=0 cellSpacing=0>

<TR>
```

```
<TD><strong>Event Type:</strong></TD>

<TD>

<SELECT id="event" name="event">

<OPTION value="PE">Physician Encounter</OPTION>

<OPTION value="LR" SELECTED>Laboratory Requisition</OPTION>

<OPTION value="RX">Prescription</OPTION>

</SELECT></TD>

<TR>

<TD><STRONG>Condition:</STRONG></TD>

<TD><INPUT id=icdcodes name=icdcodes ></TD>

</TR>

<TR>

   <td><strong>Test Req  #:</FONT></strong></FONT></td>

   <td>

<SELECT id="ordercodes" name="ordercodes" >

<option value="" selected></option>

<option value="7788-7">7788-7 -   ABO GROUP&amp; RH TYPE</option>

<option value="223-8">223-8 - ALBUMIN</option>

<option value="234-9">234-9 – ALKALINE PHOSPHATASE (AP)</option>
```

```html
<option value="823-10">823-10 -  ALT   (SGPT)</option>

<option value="243-11">243-11 -  AMYLASE</option>

<option value="249-12">249-12 -  ANTINUCLEAR    AB (ANA)</option>

<option value="822-13">822-13 -  AST   (SGOT)</option>

<option value="34388-1">34388-1 - BASIC METABOLIC PANEL</option>

<option value="285-14">285-14 -  BILIRUBIN, DIRECT</option>

<option value="287-15">287-15 -  BILIRUBIN, TOTAL </option>

</SELECT>

</TD></TR><TR>

<TD><strong>Drug Code:</FONT></strong></FONT></TD>

<TD>

<SELECT id="drugcodes" name="drugcodes">

<option  value="" selected></option>

<option value="514">514 - ACE INHIBITORS</option>

<option value="1270">1270 - ACNE PRODUCTS</option>

<option value="1032">1032 - ADRENAL CORTICOSTEROIDS</option>

<option value="1182">1182 - ALLERGENIC EXTRACTS</option>

<option value="513">513 – ALPHA AGONISTS/ALPHA BLOCKERS
</option>
```

```
<option value="633">633 - ALZHEIMER-TYPE DEMENTIA</option>

<option value="352">352 - AMINOGLYCOSIDES</option>

<option value="1720">1720 - ANALGESICS, GENERAL</option>

<option value="1721">1721 - ANALGESICS-NARCOTIC</option>

<option value="1722">1722 - ANALGESICS-NON-NARCOTIC</option>

</SELECT>

</td>

</tr>

<TR>

<TD><STRONG>Sex</STRONG></TD>

<TD>

<SELECT name="patientsex">

<option value="Male" >Male</option>

<option value="Female" selected>Female</option>

</SELECT>

</TD>

</TR>

<TR>

<TD><STRONG>Age (Y)</STRONG></FONT></TD>
```

```
5    <option value="1722">1722 - ANALGESICS-NON-NARCOTIC</option>

10   <TD><STRONG>Sex</STRONG></TD>

15   </SELECT>
```

```
<TD><INPUT id=patientageyears  name=patientageyears size="3"></TD>

<TR>

<TD><STRONG>Age (Mo)</STRONG></TD>

<TD><INPUT id=patientagemonths name=patientagemonths

size="2"></TD>

</TR>

<TR>

<TD><STRONG>Age (Days)</STRONG></TD>

<TD><INPUT id=patientagedays name=patientagedays size="2"></TD>

</TR>

<TR>

 <td><STRONG>Target:</STRONG></td>

 <TD>

<SELECT id="target" name="target">

<option value="Patient" selected>Patient</option>

<option value="Physician">Physician</option>

</SELECT>

 </TD></TR>

<TR>
```

```
<TD><STRONG>Health Plan:</STRONG></TD>

<TD>

<SELECT id="healthplan" name="healthplan">

<option value=1  selected>AUSHC Aetna US Healthcare</option>

<option value=2>CGM CIGNA All Plans</option>

<option value=7>Foundation Health Systems</option>

<option value=5>Kaiser Permanente</option>

</SELECT>

</TD></TR>

<TR>

<TD valign='center'><input id="Run" name="Run" value="ZeroSearch"

type="submit"></TD>

</TR></TABLE></FORM></BODY></HTML>
```

In this example, the user will interact with the Palm VII cHTML

display controls to enter the event type and parameters. When a

"ZeroSearch" button such as that depicted in the **Figure 4A** is clicked, the

cHTML form is posted to the application server 22 through a proxy server

that connects the wireless network 16 to the Internet. The cHTML form and

its values are submitted and processed by the application server 22 just as a standard HTML form would be processed. The response from the server is formatted in cHTML and contains verification of the submitted values.

From an application example perspective, the healthcare data in the code received by the application server 22, in combination with other information if available, will help determine a set of preferred patient education information and compose a personal "MyMedstory" (trade mark) document for the patient in question, as described in the above referenced U.S. patent application. The delivery of this "document" may take multiple forms, including but not limited to delivery on WAP platforms that include mobile telephones and other appliances. The healthcare provider entering the code may also have access to the same document or a modified one, according to the chosen application logic.

The described "WirelessMed" system can be used to transmit information to any and all end users that may need the information, in addition to the patient. This includes, but is not limited to, insurance and managed care companies, medical record companies, other medical service organizations, other physicians or content distribution services, as described in the above referenced U.S. patent application.

Security is an essential component of any medical information system. In the context of the present invention, security of information may be achieved in a variety of ways including, but not limited to, encryption and digital signatures and authentication. Such capabilities can be expected

5   to be bundled with the cellular technology provider software.

The method and system of the invention provide a number of features. Firstly, the system provides a new user experience for physicians or healthcare providers. The system provides a communication mechanism for transmitting useful healthcare information to the various players in the

10   delivery chain. This mechanism allows for either concurrent or retrospective coding. The system facilitates relaying of the information to an Internet-based infrastructure without a traditional computer. The system provides two-way interactivity with the client being "called" as well, which allows for verification of information and other interactions that may be deemed

15   useful. The information transmitted might, for example, require verification (re-entry) or additional information in order for the server to proceed with its task. Two-way communication devices such as cellular phones or personal communication assistants allow for such interactions. For example, if the system is used to enter an order for a clinical laboratory test, the initial

data may have to be supplemented in order for the order to go through; as another example, certain types of information may require more data from the user than was inputted, such data including, but are not limited to, other and additional codes to describe the clinical condition.

5   This feature can be implemented, for example, in the application server 22. The system further provides for integration of voice and data, increased ease-of-use and deployment with standardization of the interface, and mobility and ubiquity. Standard interfaces may be developed for large or smaller groups of users. For example, a "superbill" (defined for example

10   as the most common set) of codes for a given specialty or subspecialty may be pre-defined and all physicians or providers in a given network or group may then use the same superbill. Such superbills may vary according to regions or populations, for example. Since the devices are hand-held or portable, and can carry many other functions, they are highly mobile,

15   allowing for the users to always have rapid access to critical information, such as lists of codes. Since the wireless network can support as wide an area as necessary, codes can be entered from any location supported by the networks, making the solution ubiquitous (for example, a provider may be changing hospital, region or even country).

For example, for verification purposes, the communication may be done by voice, whereby the system reads back the entry and asks for confirmation either digitally or by voice as well; as another example, after entry of one or several codes, the system may require further data. This

5   request can be placed by voice.

Figure 5 is a flow chart illustrating a method 40, according to exemplary embodiment of the present invention, of communicating healthcare information to and from a portable hand-held device. **Figure 5** illustrates exemplary activity on both a server side and a client side, the

10   activities illustrated in this flow chart having been described above.

Thus a method and system for communicating health care information to and from a portable, hand held device have been described. Although the invention has been described with reference to specific exemplary embodiments, it will be evident that various modifications and

15   changes may be made to these embodiments without departing from the broader spirit and scope of the invention. Accordingly, the present specification and drawings are to be regarded in an illustrative rather than a restrictive sense.